GOOD PRACTICE GUIDE 194

Building your own energy efficient house

- Why save energy
- How to achieve integrated design
- Checklist for a low energy home
- Further information

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GOOD PRACTICE GUIDE 194

BEST PRACTICE PROGRAMME
HOUSING ENERGY EFFICIENCY
BEST PRACTICE PROGRAMME

INTRODUCTION

The Jones family

The Jones family wanted their home to have low running costs, but with little or no additional build costs.

Their design has:

- *A south-facing orientation*
- *Good wall insulation (U-value of 0.30 W/m²K)*
- *250 mm loft insulation*
- *125 mm floor insulation*
- *Double glazing with 'low-e' glass + argon*
- *'A' rated gas condensing boiler with radiators*
- *Thermostatic radiator valves, room thermostat and programmer*
- *50 mm sprayed insulation on hot water cylinder*

SAP = 105

Annual heating and hot water costs = £246 based on floor area of 2500 ft² (232 m²)

INTRODUCTION

An energy efficient house will be warm, comfortable and have low running costs. It will also cause less damage to the environment. This Guide introduces the most important concepts to think about when including energy efficiency measures into a house design. Energy efficiency features need not be expensive or use unproven technology – simple, cheap, tried and tested measures are often the best. A small additional cost of around 50p - £1/ft² (£5-10/m²) is enough to give a good energy efficient house. With fears of rising fuel prices and global warming, houses are becoming more energy efficient. Thinking about the future when building your house will go towards providing you with a quality home for many years to come.

INCLUDING ENERGY EFFICIENCY IN YOUR HOUSE DESIGN

The best time to include energy efficiency measures is when a house is being designed and built. Incorporating energy efficiency from the beginning will give you maximum benefits for the least cost. The maximum benefit from energy efficiency measures will only be obtained from an integrated approach, ie combining a number of complementary measures into a comprehensive package rather than the ad hoc inclusion of single measures. Use the checklist given in this Guide to ensure that energy features are fully integrated. Upgrading the energy efficiency of a house design need not involve high additional costs.

For example, the extra costs of additional insulation can be offset against savings from being able to install a smaller heating system.
For more information on all of the subjects in this Guide there is a further reading list suggested on the back page.

STANDARD ASSESSMENT PROCEDURE (SAP) AND BUILDING REGULATIONS

The SAP is an energy rating which estimates the space and water heating costs of a house (based upon its size, heating system and standard assumptions such as occupancy pattern) and converts it into a rating on a scale from 1 to 120; the higher the number, the lower the energy consumption. The SAP is a useful design tool for comparing houses and can be used to assess the benefits of different energy efficiency measures.

The Building Regulations Part L1 (Conservation of fuel and power) requires basic levels of insulation. However if it is your intention to build an energy efficient house then you should regard these Regulations as an absolute minimum. Although there are three basic methods for demonstrating compliance with Part L1, (ask your architect or package supplier for more information on this) a high SAP rating will also save effort by providing most of the information that is needed to prove compliance.

The fictitious examples on this page (Jones) and page 3 (Smith) show how SAP ratings can be used to improve energy efficiency at the design stage.

CHOOSING YOUR SITE

Using the sun to heat your house saves energy and makes it more pleasant. If possible choose a site which allows your house to face south (±45°), ideally with shelter from prevailing winds, but without shading to the house. The total window area shouldn't be increased, but most of it should face south to benefit from solar gains. External blinds can be used to prevent overheating in summer months. Some windows will need to face north to ensure good daylight in all rooms.

[1] This applies to England and Wales. Use Part J in Scotland and Part F in Northern Ireland. These have slightly different requirements to Part L1.

ENERGY SAVING MEASURES

The Smith family

Unlike the Jones family the Smiths did not specify energy efficiency, so their house was only designed to meet the minimum requirements of the Building Regulations. Their design has:

- *Basic wall insulation (U-value of 0.35 W/m²K)*
- *250 mm loft insulation*
- *80 mm floor insulation*
- *Double glazing with 'low-e' glass*
- *'D' rated gas boiler with radiators*
- *Thermostatic radiator valves, room thermostat and programmer*
- *30 mm sprayed insulation on hot water cylinder*

SAP = 94

Annual heating and hot water costs = £309 based on floor area of 2500 ft² (232 m²)

INSULATION

A large part of the heat lost from a house is through the walls. Whichever method of construction you choose, building in insulation is the easiest and cheapest way of improving energy efficiency. Standard timber frame walls (90 mm) can easily be upgraded by specifying 140 mm studs which allow more insulation, and masonry walls can be improved using fully filled 100 mm cavities and lightweight 'thermal' blocks. Both of these will give a U-value better than 0.30 W/m²K. (The U-value is a measure of the thermal performance of part of the building. The lower the better.) For severe weather locations where fully filled cavities are not suitable, partially filled cavities can be used.

Lofts should have at least 250 mm of insulation: 100 mm laid between the joists and 150 mm laid across them. This gives a U-value of 0.16 W/m²K. Rooms in the roof and dormer windows need careful attention to detail but can also be insulated to a high standard. Ground floor heat loss calculations are more difficult and there are many different types of floors, but all are easily insulated during construction. A layer of 125 mm polystyrene (or equivalent) is recommended, but for underfloor heating, increase the insulation to minimise the heat losses to the ground.

HOUSE LAYOUT

When thinking about the design of your house, remember, a compact plan without 'extensions' minimises the external wall area, reduces heat losses and minimises shadowing by other parts of the house. A bungalow will lose more heat than a two- or three-storey house of the same floor area. Rooms which are used most should be on the south side to take advantage of solar heat gains. For rooms which are used mostly in the mornings, such as kitchens and breakfast rooms, a south-east orientation is best to get full benefit from the morning sun. Halls, stairs and less frequently used rooms like bathrooms can go on the north side.

WINDOWS

Double glazing with 'low-e' coating should be considered a minimum in most new homes. It reduces heat loss and offers some sound insulation. Other features such as argon-filled units and triple glazing are well worth considering.

CONSERVATORIES

Conservatories can help to save energy by reducing heat losses through adjoining walls (called buffering) and trapping heat from the sun, but the savings are small. To be effective they should be on the south side of the house and not be overshadowed. Even high quality conservatories should not have any permanent heating as this can lead to very high fuel bills, and there should be double glazed doors to shut them off from the rest of the house when unused.

HEATING YOUR HOUSE – making the right choices

Low energy houses require smaller and simpler heating systems than other houses of a similar size, because heat losses are low. Your choice of heating system should take into account the availability of fuels, the time you will spend in your home and its type of construction.

Ideally, a lightweight construction like timber frame should be matched with a responsive heating system which is quick to supply heat where and when it is needed.

An example would be a warm air system or radiators with thermostatic radiator valves (TRVs), installed in a timber frame house which is occupied morning and evening. Underfloor and other 'storage'

ENERGY SAVING MEASURES AND SITE PRACTICE

systems are less suited to very lightweight constructions as they cannot generally respond as quickly.

As wet underfloor systems can have radiators as well as underfloor heating circuits, a combination of underfloor heating in the downstairs rooms and radiators elsewhere is a worthwhile compromise. A tiled solid screed floor works best with underfloor heating and rugs, instead of fitted carpet. Condensing boilers, have efficiencies up to 90% and are more efficient than conventional boilers. They can be used in place of an ordinary boiler for both radiators and underfloor heating, the only difference being the need for a small outlet to the drainage system for the condensed flue gases.

If you want a focal fire then multi-fuel stoves are a good option especially if you are able to take advantage of free fuel such as wood. These are also much more efficient than open fires, and won't give such high heat losses through the flue from increased ventilation when they are not being used.

Hot water efficiency is governed largely by the efficiency of the boiler rather than the type of hot water system, eg mains pressure, unvented etc, but the more insulation around the store the better (50 mm plus). Good controls are important to maximise the efficiency of a heating system and are required to comply with Building Regulations. Individual room control is particularly important in rooms with large south-facing windows. If your house will have two or more distinct parts which will be used at different times, eg an annexe or office, zone controls may be worth considering. Choose controls that are easy to use and fit them where they are easily accessible.

VENTILATION

Ventilation is important to provide fresh air and prevent condensation. There must be extract fans or passive stack ventilation (PSV) in kitchens and bathrooms to satisfy Building Regulations. PSV uses the principle of rising warm air to extract without the need for electric fans. Permanent ventilation must also be provided to all other rooms using 'trickle vents'. Draught lobbies (unheated) on main entrances help reduce heat losses and are recommended. Mechanical ventilation with heat recovery may offer benefits such as filtered air and reduced noise intrusion. However, they should not generally be seen as an energy efficiency feature since the cost of the electricity used to run fans often outweighs the benefits from the heat recovery. They also need a well sealed house to work efficiently – no open chimneys or flues.

LIGHTING

Maximising daylighting and good lighting design, combined with the use of compact or strip fluorescent lights, will save considerable amounts on running costs. Fluorescent lamps also have a much longer life than ordinary light bulbs. The most important places to fit them are where lights are left on for long periods, eg outside light, halls and stairs, and main living areas.

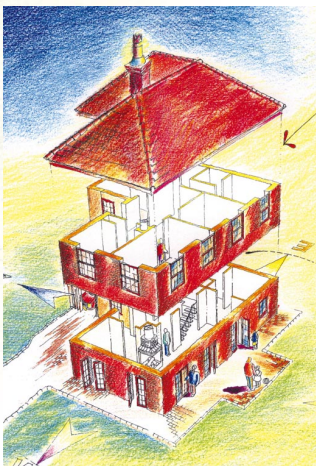
BRIEFING DESIGNERS

Many architects and designers will be aware of energy efficient principles, but often they will be designing homes that don't go beyond Building Regulations. You don't need to specify fine details to achieve an energy efficient design. Instead, give the designer a target to work to – perhaps improving the initial design by 10 SAP points, setting maximum running cost or U-value targets. To help achieve an energy efficient design:

- Choose an architect or package supplier who has knowledge of low energy design
- Provide references for low energy techniques and measures
- Discuss your aims and reasons for wanting a low energy design
- Provide a target SAP energy rating or running cost
- Explain how you will use your house, eg all day or morning and evening

SITE PRACTICE

Good site supervision and proper materials storage are critical to the success of energy efficiency measures. Potential problems such as gaps in insulation materials or damaged double glazed units can be easily overcome with careful supervision during building. If you are managing the project yourself, pay particular attention to details like insulation junctions and where services enter the house. Insulation should be kept dry to avoid damage and prolonging the drying out period.



A CHECKLIST FOR A LOW ENERGY HOME

1

Get the right team:

- ☐ Choose an architect or package supplier with knowledge of and enthusiasm for low energy design
- ☐ Brief builders on the low energy aim of your house
- ☐ Select tradespeople with knowledge and experience of energy efficiency

2

Minimise heat losses:

- ☐ Design a compact house plan
- ☐ Ensure high levels of insulation in all external elements (including windows)
- ☐ Provide controlled ventilation
- ☐ Draughtstrip all external openings
- ☐ Ask your architect for energy calculations eg expected fuel bills

3

Maximise solar heating:

- ☐ Orientate your house towards south
- ☐ Locate most windows on the south side and reduce size of north-facing windows
- ☐ Place living rooms and main bedrooms on the south side
- ☐ Install a responsive heating system and controls

4

Install an efficient heating and hot water system:

- ☐ Size the system correctly
- ☐ Fit condensing boilers (oil or gas) where possible
- ☐ Install good, easy-to-use controls

5

Ensure the success of energy measures:

- ☐ Overlap insulation between elements eg between loft and walls
- ☐ Keep cavities clear of debris
- ☐ Don't compress insulation materials
- ☐ Keep insulation materials dry
- ☐ Seal holes where services enter your house

6

And when moving in:

- ☐ Make sure you understand the heating system
- ☐ Set heating controls to suit your needs
- ☐ Fit low energy lights
- ☐ Allow the house to dry out - particularly masonry houses
- ☐ Buy low energy appliances
- ☐ Avoid permanent shading, such as net curtains, that stop solar gains

FURTHER READING

FURTHER INFORMATION

There are numerous sources of further information. The following Best Practice programme publications are available from BRECSU enquiries bureau – contact details are at the bottom of the page.

BEST PRACTICE PROGRAMME

Low energy design –
Good Practice Guide 79

Produced to help technical and non-technical professionals in the housing industry understand the issues affecting energy and incorporate efficiency measures in new homes. Originally written for housing associations, it is highly relevant to all new housing where high energy efficiency standards are required.

Passive solar design –
Good Practice Guide 73

This Guide provides information on how to exploit the freely available energy of the sun for daylighting and heating without the need for exotic designs.
It also allows readers to understand how orientation and glazing can contribute to the energy efficiency of new houses.

Domestic ventilation –
Good Practice Guide 264

Ventilation is of increasing importance in new energy efficient houses. This Leaflet is suitable for individuals, builders and professionals. It discusses both the need for correct ventilation and the options for its provision.

Energy efficient refurbishment of existing housing – Good Practice Guide 155

For refurbishment projects this Guide provides information on improving the energy efficiency of a range of common construction types likely to be encountered. Designed to help both technical and non-technical professionals, the Guide provides information on how to set and achieve high standards of energy efficiency when refurbishing existing housing.

OTHER AUTHORITATIVE INFORMATION

Thermal Insulation: avoiding risks

Produced by the Building Research Establishment to support Part L of the Building Regulations, this document provides detailed information on good design and construction practice. It highlights how to avoid the more important technical risks associated with complying with the Building Regulations and energy efficient design.
CRC publications 01923 664444
(ISBN 1 86 081 5154)

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Energy Efficiency Best Practice in Housing

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